Radiothermoluminescence of Anthracene-Tetracene Mixed Crystal (Special Issue on Physical, Chemical and Biological Effects of Gamma Radiation, V)

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Radiothermoluminescence of Anthracene-Tetracene Mixed Crystal

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The radiothermoluminecence glow curves of various Anthracene-Tetracene mixed crystals which included six sorts of Tetracene contents, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} and 0 grams of Tetracene/grams of Anthracene (gr/gr) have been observed for various radiation doses in the temperature range 77°K to 273°K. It was found that both of the glow intensities and the saturation doses becomes larger as the Tetracene content become larger. Numerically, the crystal of Tetracene contents, 10^{-3} and 10^{-6} (gr/gr) shows saturation doses of glow intensities at 10^6 r and 10^3 r, respectively. It must be concluded that the Tetracene molecule acts as a trap of electrons which are emitted by the irradiation.

Radiothermoluminescence in inorganic substances has been studied over quite a long period and the mechanisms are made fairly clear, but little is known in organic systems[1,2,3].

However, radiothermoluminescence in organic substances has been investigated by several authors with the purpose to investigate intermediate species which can store the radiation energy and to analyze the path along which the quantum of absorbed energy produces the final effects.

To make clear the mechanisms of radiothermoluminescence in organic substances, we studied the Anthracene crystal because it is a simple organic material.

Then, we measured dose dependency of glow intensities of Anthracence-Tetracene mixed crystals added six different Tetracene contents as impurities, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} and 0 (gr/gr) in Anthracene and discussed some effects of Tetracene contained.

Anthracene-Tetracene mixed crystals were prepared in the following procedure. Ordinary powder Anthracene was purified to high degree by two steps. The first step is the chemical purification and the second is the zone melting method. Next, the known quantity of Tetracene was mixed into very pure Anthracene thus obtained and the single crystals were made from this mixture by the Bridgman method.

Each sample was irradiated by ^{60}Co γ-rays at 77°K and brought into the apparatus described in the previous paper[4].

The experimental results are shown in the figure where the area of glow

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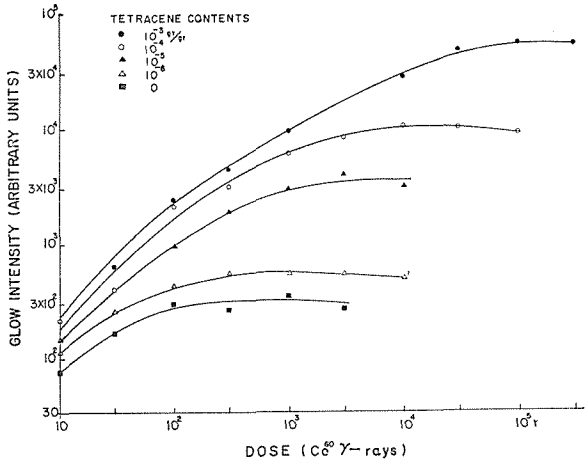

Fig. 1. Dose dependency of glow intensities of various Anthracene-Tetracene mixed crystals.

curves is plotted as a function of dose. Here, a sample of Tetracene content, 10^{-7} (gr/gr) was omitted because it shows the similar result to pure Anthracene (0 gr/gr).

The results show the following informations.

(1) For the low doses, all samples have similar glow intensities independent of the Tetracene content which are linearly increased function of dose.

(2) The saturation doses of glow intensities are proportional to Tetracene contents. This is reasonable if Tetracene molecule traps electron emitted by γ-rays and if phenomenon of saturation is induced as soon as all traps have been filled by electrons.

From the above results, it must be concluded that Tetracene or imperfection around the Tetracene or both act as a trap of electrons which are emitted by the irradiation.

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